FUNcube from AMSAT-UK

Launch and Early Operations

Orlando 2012

David Bowman G0MRF

FUNcube from AMSAT-UK

- *The FUNcube project - overview*
- *Current status*
- *FUNcube-1 hardware*
- *Dnepr launch from Yasny Q1 2013*
- *Early operations*
- *Educational outreach and amateur radio schedule*

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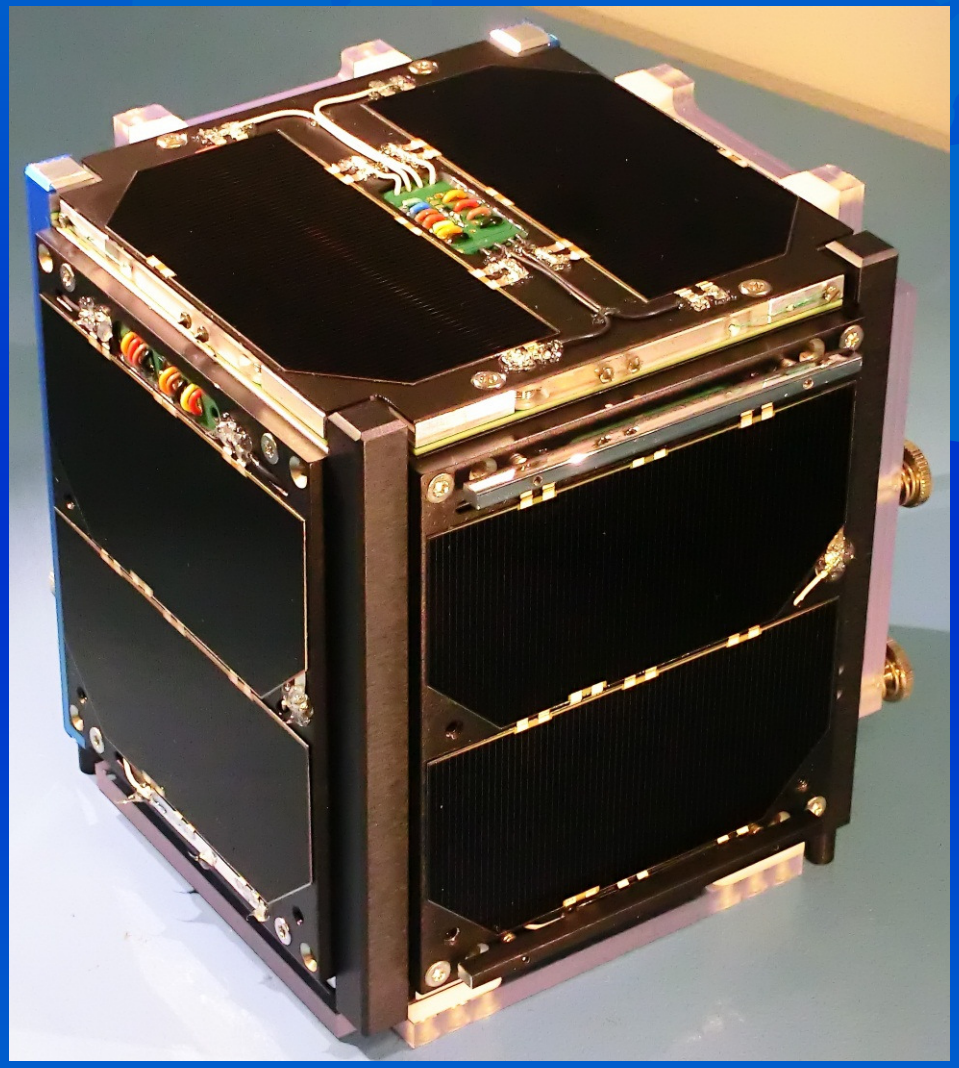
FUNcube project overview

- Construct and launch a 1U CubeSat to include an amateur radio transponder and to provide educational outreach to inspire students in STEM subjects
- To retain / enhance the expertise required within the UK
- To encourage and provide hardware to other small satellite groups
- To pursue launch opportunities on behalf of the AMSAT membership

Current Status

FUNcube-1



Flight model in thermal vacuum / vibe tests.

FUNcube-2

3 FM boards delivered to Clydespace (Scotland) for UKube-1 3U CubeSat

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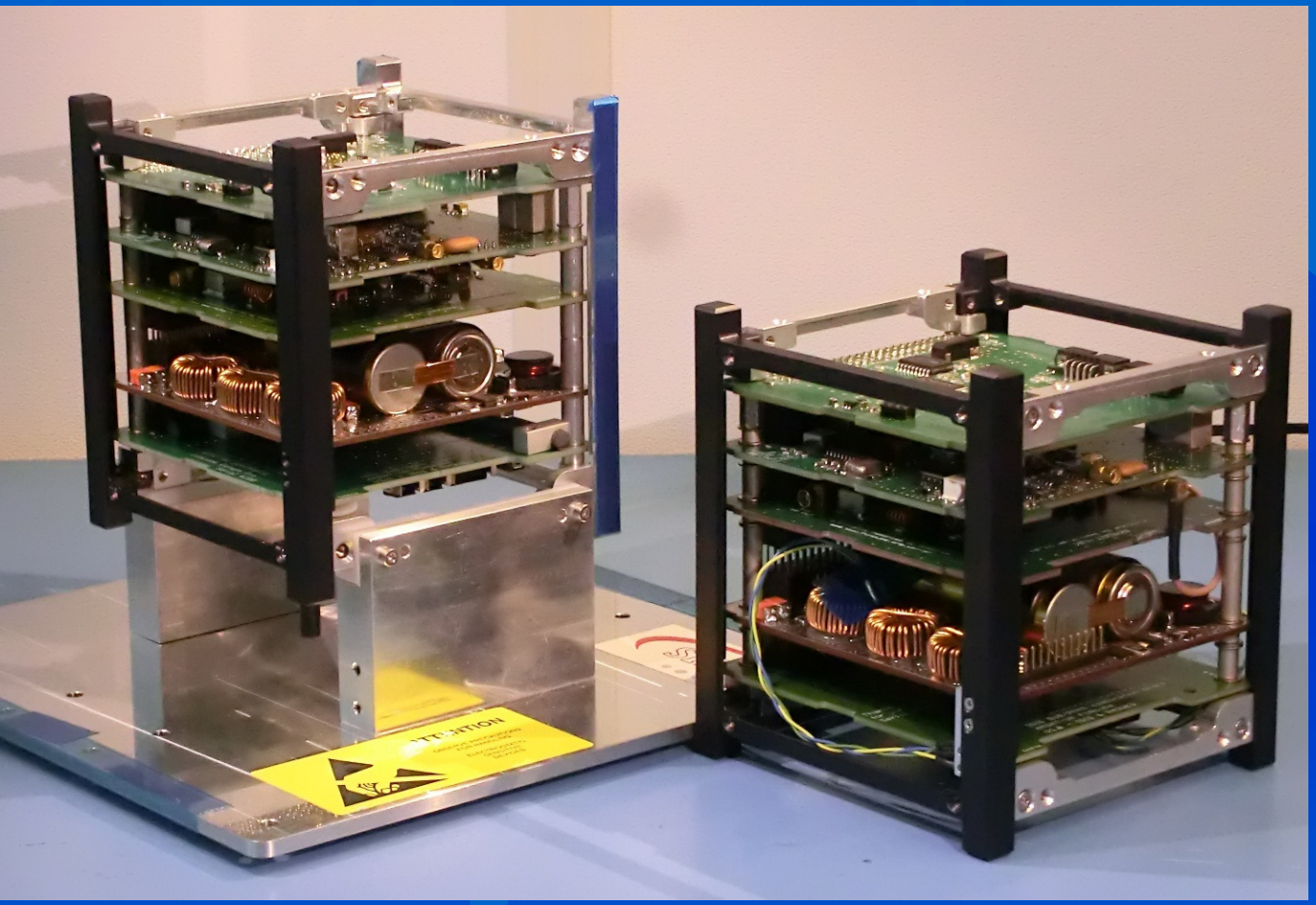
FUNcube-1 Hardware



CCT board. AMSAT-UK
Transponder. AMSAT-NL
2m Amplifier AMSAT-UK
Power system Denmark
Structure ISIS (Netherlands)
Antenna system ISIS

Solar panels:
Solar cells Germany
Aluminium mounting Israel
Assembled in Italy

United States…… (ITAR)

Flight model

Engineering model

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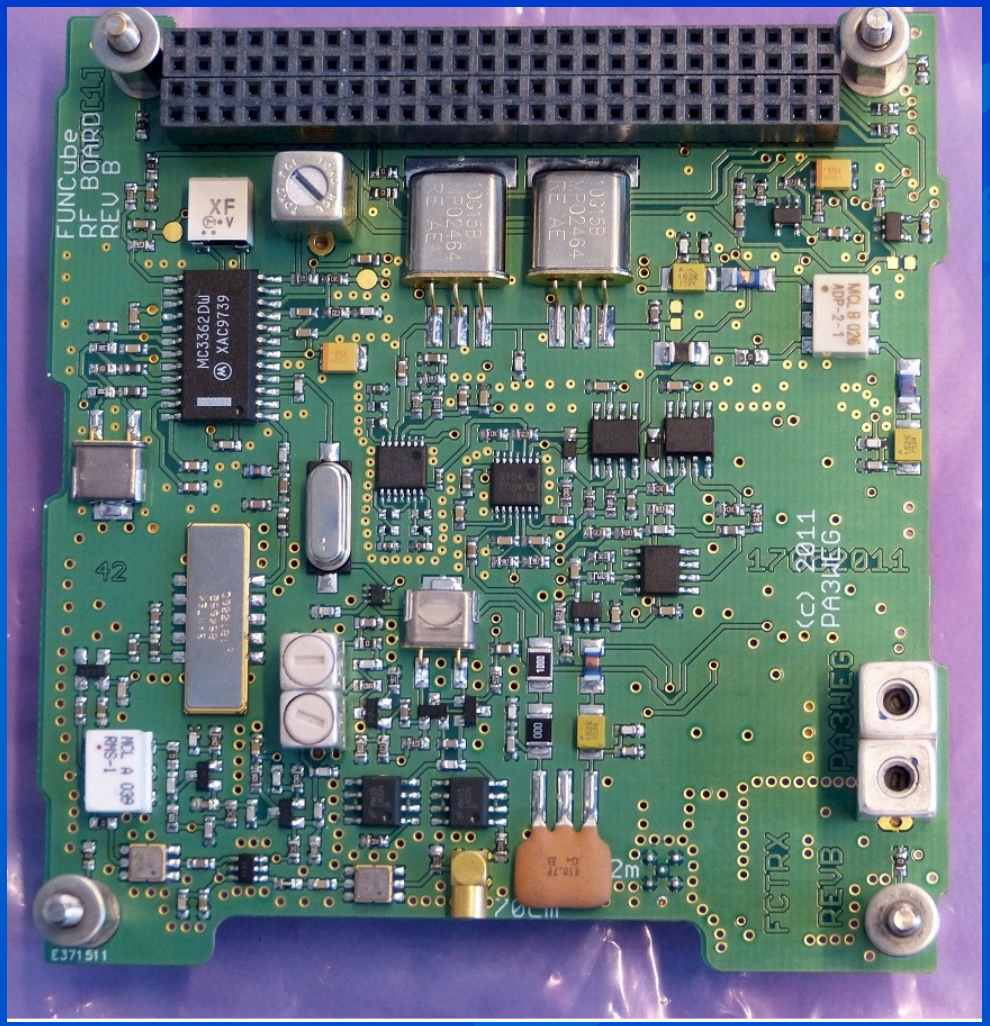
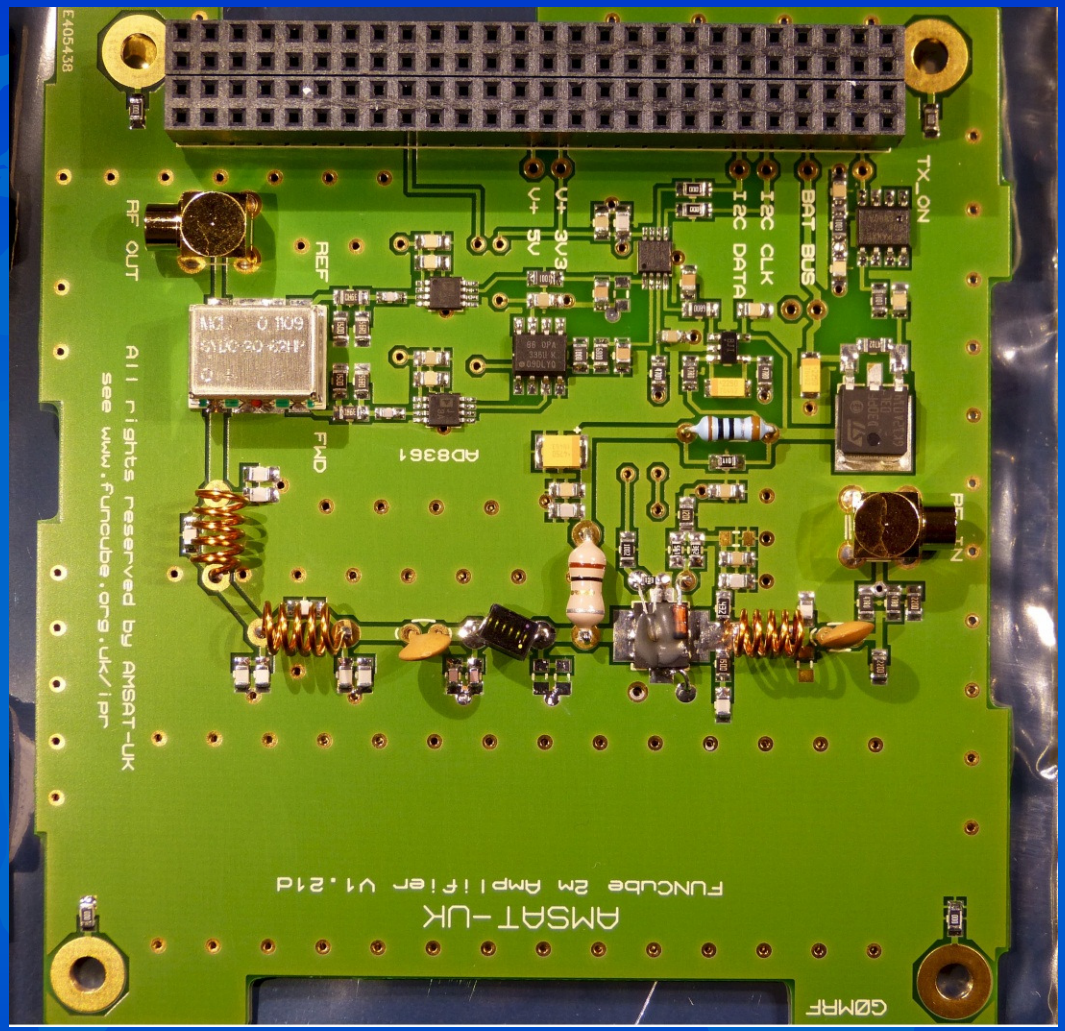
FUNcube-1 Hardware

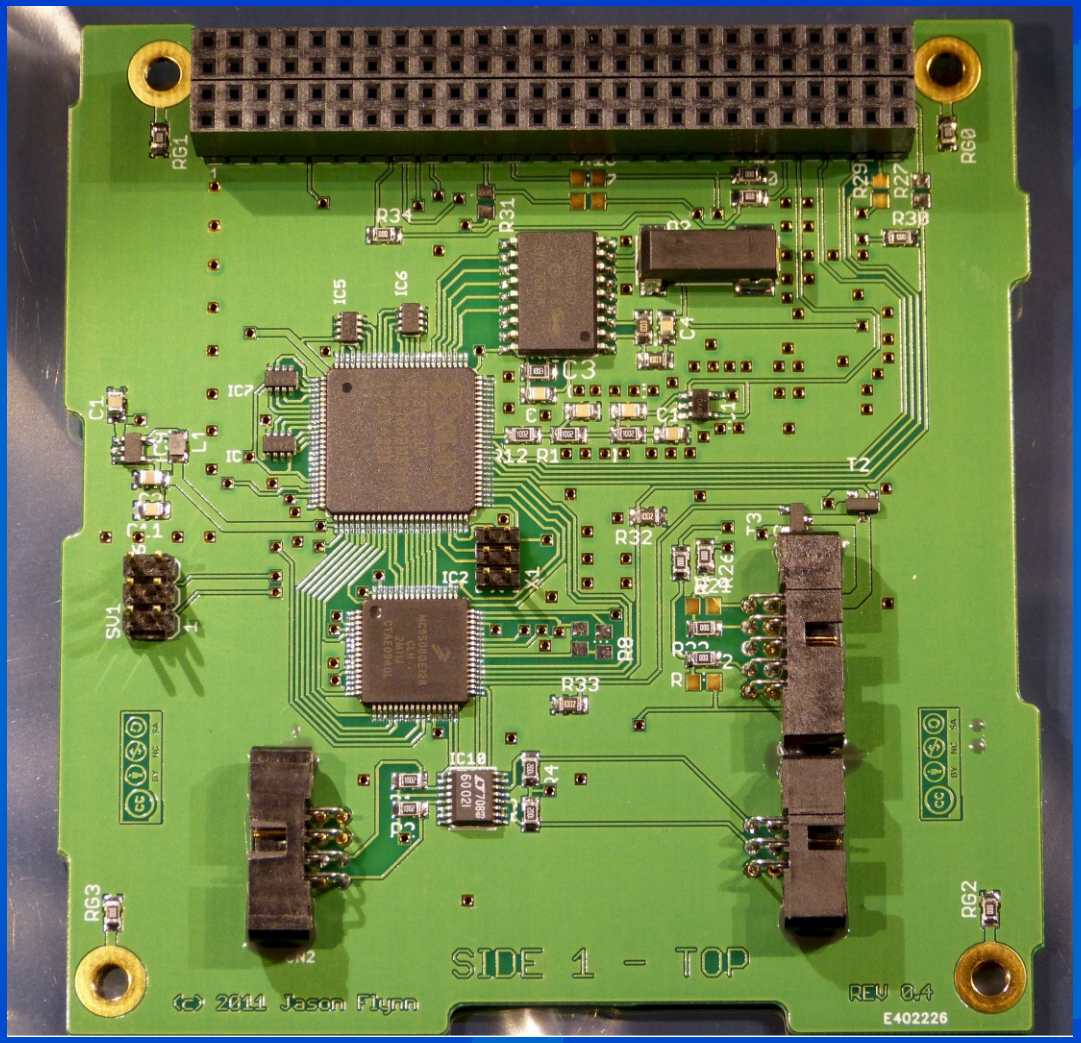




RF Board PA3WEG
Command receiver + 19kHz UV transponder
Also (end of life) FM to DSB

145 MHz Amplifier RD02MUS1 FET
+ 4 channels of telemetry via I2C bus

FUNcube-1 Hardware

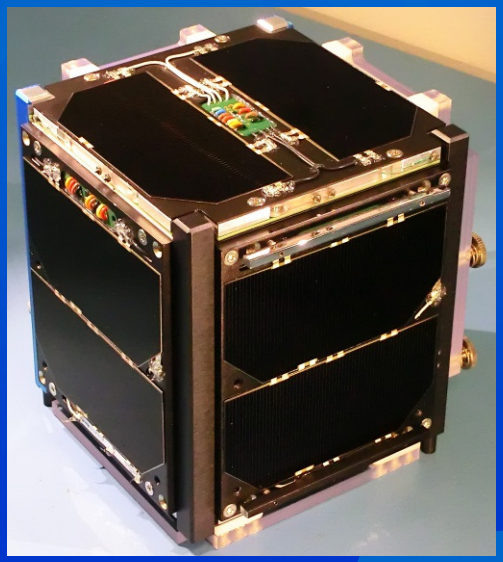


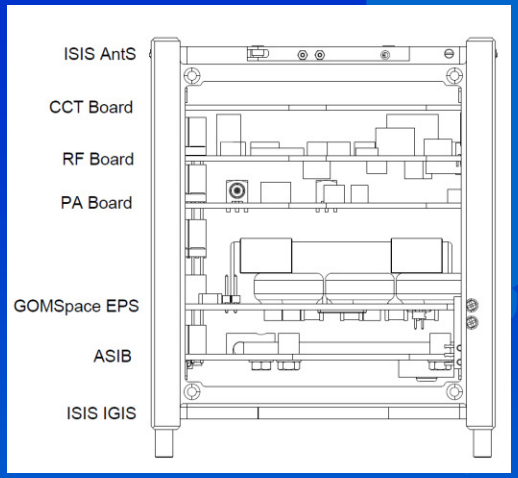
Command Control + Telemetry Board

- Xilinx CPLD command decoder
- Freescale CPU for telemetry generation
- 2 x I2C Bus

- 3.3V supply
- Average power consumption 15mW
- Peak power 33mW

FUNcube-1 Telemetry





1200BPS BPSK with forward error correction
54Telemetry channels
Telemetry sent in 24 x 5second frames over 2 minute period
Real time
Whole orbit data sampled every 60 sec stored for 104 minutes
'Fast' data sampled at 1 second intervals for 60 seconds
Text messages. 9 x 200 character greetings messages
27 additional messages stored in memory

Very distinctive sound to enable easy identification.
4.3 seconds of data + 0.7 seconds of unmodulated BPSK tone
(sample tlm)

Satellite also transmits a 24 bit sequence number and a 2 bit satellite identifier which allows groundstation software to identify the satellite and route the data to a 'data warehouse'

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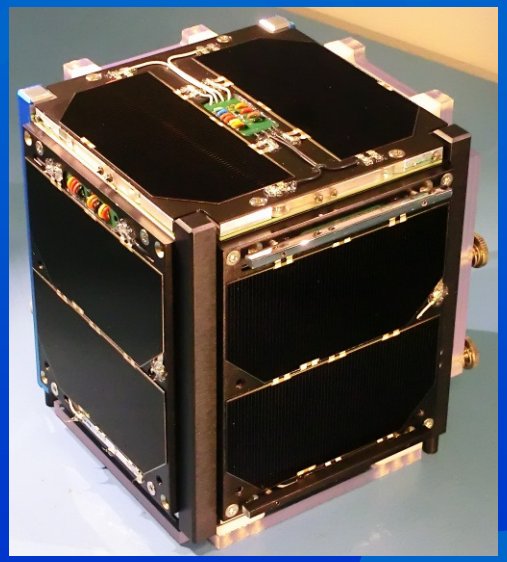
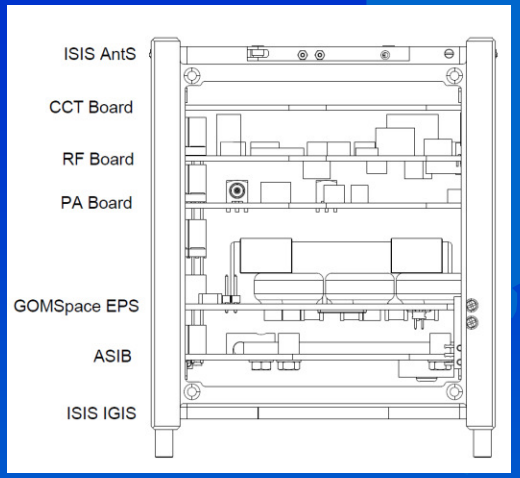
FUNcube-1 Telemetry





Frame Type	Frame Id	Frame type
RTT + Whole Orbit	WO1	01
RTT + Whole Orbit	WO2	02
RTT + Whole Orbit	WO3	03
RTT + Whole Orbit	WO4	04
RTT + Whole Orbit	WO5	05
RTT + Whole Orbit	WO6	06
RTT + Whole Orbit	WO7	07
RTT + Whole Orbit	WO8	08
RTT + Whole Orbit	WO9	09
RTT + Whole Orbit	WO10	10
RTT + Whole Orbit	WO11	11
RTT + Whole Orbit	WO12	12
RTT + High Resolution	HR1	13
RTT + Fitter Message	FM1	14
RTT + Fitter Message	FM2	15
RTT + Fitter Message	FM3	16
RTT + High Resolution	HR2	17
RTT + Fitter Message	FM4	18
RTT + Fitter Message	FM5	19
RTT + Fitter Message	FM6	20
RTT + High Resolution	HR3	21
RTT + Fitter Message	FM7	22
RTT + Fitter Message	FM8	23
RTT + Fitter Message	FM9	24

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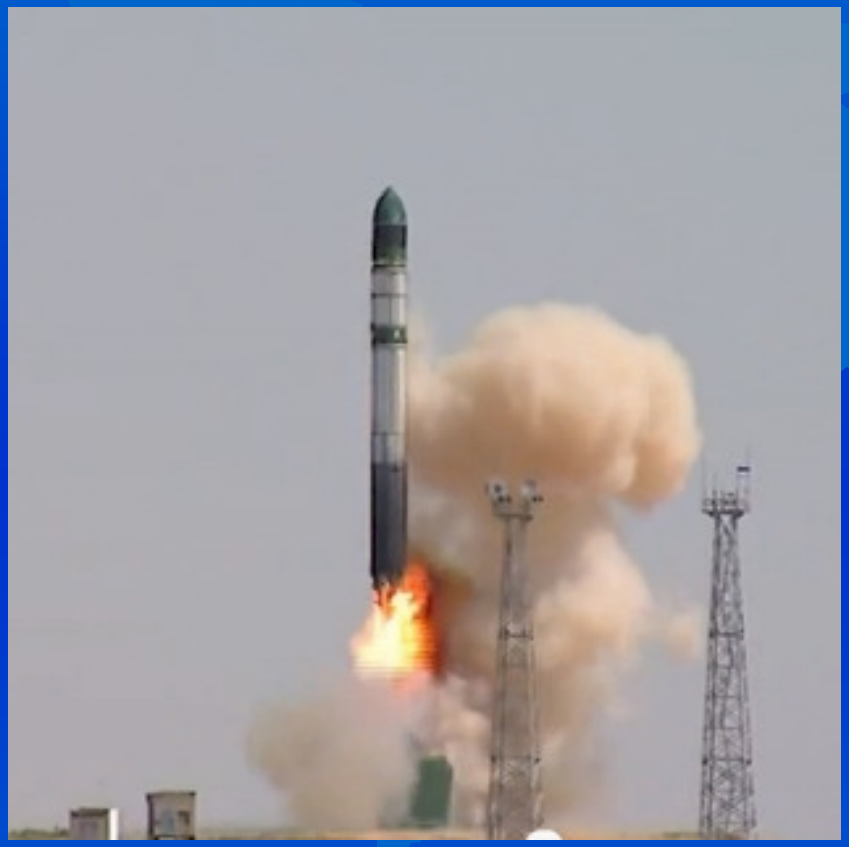
Launch status

FUNcube-1

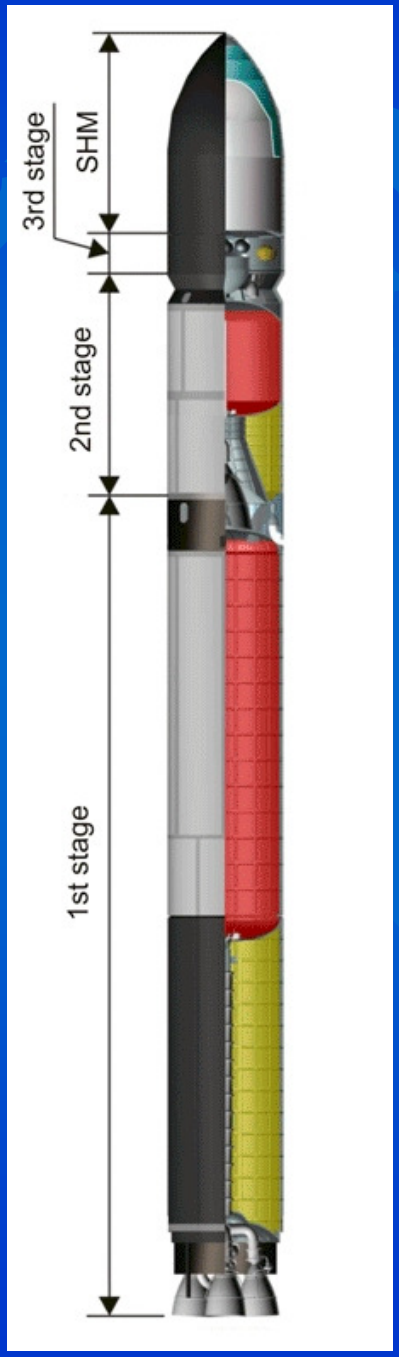


Dnepr Launch from Yasny Russia
Q1 2013

FUNcube-2 sub system on UKube

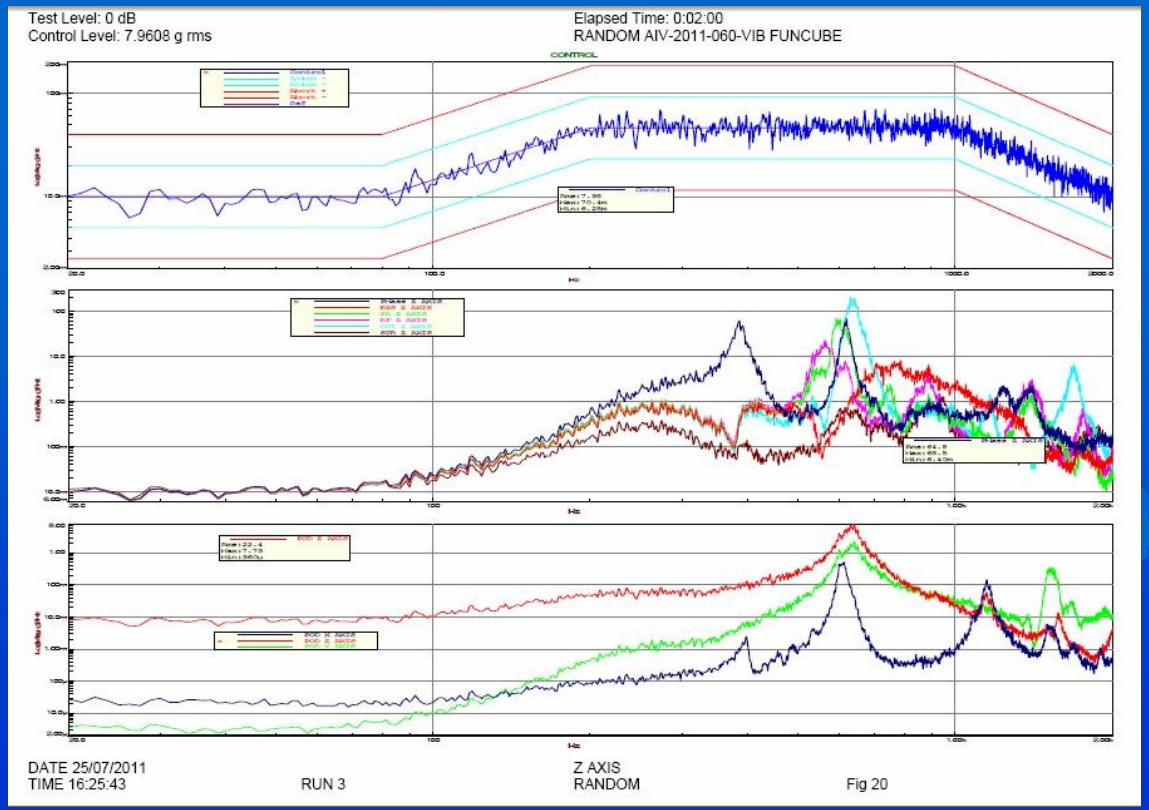
Soyuz launch from Baikonur Russia
Q1 2013

Dnepr Launch - SS-18 Intercontinental ballistic missile



- Originally set for Q4 2012 now Q1 2013
- Primary payload DubaiSat-2
  19 secondary micro and nanosat payloads
- Launch from underground silo.
  Inclination 98.2 degrees
  'near circular' Sun synchronous orbit
  Altitude 690km

Dnepr launch video



Early Operations

Antenna deployment at L+26 minutes.

Safe mode 50mW BPSK beacon
DC Power in = 3.2W Power out = 450mW

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Amateur radio transponder + modes

Mode UV Inverting transponder.

- Power output 400mW PEP to include 50mW telemetry on 145.935MHz
- AGC range 43dB

- Educational mode : BPSK telemetry at 400mW
- Amateur mode : 50mW BPSK + transponder

- Satellite can auto switch from ‘educational’ in sunlight to ‘amateur’ in eclipse

Uplink passband centre	**435.140 MHz**	Transponder uplink: 435.150 to 435.130
Downlink passband centre	**145.960 MHz**	Transponder downlink 145.950 to 145.970
Telemetry beacon	**145.935 MHz**	

Educational Outreach

Thank you

David Bowman G0MRF